Determination the effect of meteorological changes in presentations to a pandemic hospital

Eurasian Clinical and Analytical Medicine Original Research

The effect of meteorological changes in presentations to a pandemic hospital

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Abstract

Aim: Atmospheric pressure, air temperature, humidity, or sudden meteorological changes alter COVID-19 patient admissions. In the present study, we aimed to investigate the seasonal distribution of COVID-19 disease and its relationship with meteorological changes in our province, where the continental climate is dominant.

Material and Methods: This is a retrospective study. Patients who presented to our hospital's pandemic outpatient clinic were enrolled. Patients' time of presentation, the number of presentations and hospital outcomes were recorded. Daily meteorological data pertaining to the study period including air temperature, atmospheric pressure, humidity rate, amount of precipitation, and wind speed were obtained from the Directorate of Meteorology and recorded.

Results: During the 112-day study period, 11,898 patients presented to the pandemic outpatient clinic, and 2568 PCR (+) cases were detected. A total of 30 patients died during the study period. There was a significant positive correlation between the number of presentations and the mean temperature, humidity rate ($p<0.05$ for both). On the days free of restrictions, on the other hand, there was a significant negative correlation between the number of presentations and the mean temperature. There was a significant positive correlation between the number of positive cases and the humidity rate both during the entire study period and on days when restrictions were not in effect ($p<0.05$ for both).

Discussion: We found a positive correlation between the number of presentations and the mean temperature, humidity rate; there was also a positive correlation between the number of positive cases and the humidity rate. Although the number of presentations was reduced on the days when the national restrictions were not in effect, we concluded that the restrictions did not affect the relationship between the number of patients and the meteorological parameters. Interactions between air pollution and meteorological factors may play a role in the transmission and pathogenesis of COVID-19, and multi-center prospective studies may provide a better insight into such interactions.

Keywords

Infection, COVID-19, Pandemic

DOI:10.4328/ECAM.10029

Received : 2021-04-02
Accepted : 2021-05-24
Published Online : 2021-05-31
Printed Online : 2022-05-01

Eu Clin Anal Med 2022; 10(2): 5-8

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How to cite this article: Emine Emektar, Filiz Koç, Hüseyin Uzunosmanoğlu, Seda Dağar, Emine Fırat Göktaş. Determination the effect of meteorological changes in presentations to a pandemic hospital. Eu Clin Anal Med 2022; 10(2): 5-8

Introduction

The SARS-CoV-2 pandemic has been designated by the World Health Organization (WHO) as Coronavirus Disease 2019 (COVID-19). In 2002, the SARS-CoV outbreak was first reported in China, and then spread rapidly worldwide, reaching a mortality rate of approximately 11% [1]. In 2012, MERS-CoV first emerged in Saudi Arabia from where it spread to other countries, reaching a mortality rate of 37% [2, 3]. SARS CoV-2 causing COVID-19 disease also belongs to the coronavirus family; it is an enveloped RNA virus that causes severe respiratory insufficiency. COVID-19 has spread to many countries of the world, with the first case in Turkey reported on 11 March 2020 (available at: https://covid19.saglik.gov.tr/). Coronaviruses are generally not very resistant to external environmental factors. Their survival time is usually dependent on various factors such as ambient humidity and temperature, the amount of organic material in which they are excreted, and the texture of the surface they contaminate [2, 3]. Retrospective studies have shown that severe acute respiratory syndrome (SARS), which emerged in Guangdong in 2003, gradually waned with warming air and ended by July [2]. Similarly, air temperature and its variations have been shown to modify the SARS pandemic [3]. In a study reported from Korea, it was found that the risk of influenza was markedly increased by low day temperature and relative humidity; additionally, a positive correlation was shown for the daily temperature range [4]. In addition, studies have linked air temperature and daily temperature fluctuations to death from respiratory diseases [5, 6]. Similarly, another study demonstrated that absolute humidity showed a significant correlation to influenza viral survival and transmission rates [7]. Although there are a number of studies on COVID-19 disease and meteorological factors, there are only a few studies from Turkey [8-10]. Atmospheric pressure, temperature, humidity, or sudden weather changes alter COVID-19 patient presentations [11]. Some studies have reported that the spread of COVID-19 was slowed as temperature and humidity increased [8-10]. In the present study, we aimed to investigate the seasonal distribution of COVID-19 cases and their relationship with meteorological changes in the city of Ankara located in the Central Anatolian Region where the continental climate is the dominant climate.

Material and Methods

This is a retrospective study. It was approved by the local ethics committee. Our hospital has been serving as a pandemic hospital since 21 March 2020, accepting only patients with a preliminary or final diagnosis of COVID-19 in addition to emergencies presenting to the emergency department. The study enrolled patients who presented to Keçiören Training and Research Hospital Pandemic Outpatient Clinic between 21.03.2020 and 1.07.2020. Patients with combined positivity in the nasopharyngeal and oropharyngeal swab samples were considered COVID-19 positive. The time of presentation, the number of presentations and the hospital outcomes of the patients were retrospectively reviewed and recorded from the hospital automation system and the medical records.

Seasonal and monthly distributions were analyzed. Daily meteorological data pertaining to the study period, including air temperature in centigrade, atmospheric pressure in millibars, humidity rate in percentage, amount of precipitation in millimeters, and wind speed in m/sec, were obtained from the Ankara Directorate of Meteorology and recorded. Time periods with and without curfew restriction were analyzed under different groups. Patients with missing data were excluded.

Statistical Analysis

All data that were obtained and recorded in the study form during the study period were analyzed using IBM SPSS 20.0 (Chicago, IL, USA) statistical software. The Kolmogorov-Smirnov test was used to evaluate the normality of the distribution of discrete and continuous numerical variables. Descriptive statistics included the median value (IQR 25-75) for discrete and continuous numerical variables, and the number of cases and percentages (%) for categorical variables. The categorical variables were compared with the Chi-square test, and the continuous variables with Student's t-test or the Mann-Whitney U test. Spearman's correlation test was used to test correlations between continuous variables. Statistical significance was set at $p<0.05$ for all statistical analyses.

Results

During the study period of 112 days, a total of 11,898 patients presented to the pandemic outpatient clinic, and 2568 PCR (+) cases were diagnosed. Thirty patients died during the study period. Restrictions were in effect for a total of 21 days during the study period. The median number of presentations was 62 (IQR 50-65); the median number of positive cases was 15 (IQR 11-18) during the days of restriction. On the days free of restrictions, the median number of presentations was 110 (IQR 84-141), and the median number of positive cases was 24 (IQR 16-31). Table 1 presents the meteorological data in the entire study period.

Analysis of the correlation coefficients and their level of significance for the correlations between the number of presentations to the pandemic outpatient clinic and the meteorological data during the entire study period showed a significant positive correlation between the number of presentations and the mean temperature and humidity rate ($r=0.221$, $p=0.019$; $r=0.198$, $p=0.037$, respectively).

On the days free of restrictions, there was a significant positive correlation between the number of presentations and the mean temperature ($r=0.305$, $p=0.003$) (Table 2).

Analysis of the correlation coefficients and their level of significance for the correlations between the number of positive cases and meteorological data during the entire study period and on the days free of restrictions showed a significant positive correlation between the number of positive cases and the humidity rate during both times ($r=0.236$, $p=0.012$; $r=0.226$, $p=0.031$, respectively) (Table 3).

Table 1. Meteorological data measured during the entire study period

Parameters, Median, IQR (25-75)	
Mean temperature, °C	15 (10-18)
Humidity rate, %	50 (40-60)
Amount of precipitation, mm3	0 (0-2)
Wind speed, meter/sec	14 (9-19.7)
Atmospheric pressure	904 (900-906.75)

Table 2. Correlation coefficients between the number of presentations to the pandemic clinic and the meteorological data during the entire study period and on the days free of restrictions

Variables	All days (112 days)		Days free of restrictions (91 days)	
	Correlation Coefficient	p value	Correlation Coefficient	p value
Mean Temperature, °c	0.221	0.019	0.305	0.003
Humidity Rate, %	0.198	0.037	0.069	0.514
Amount of Precipitation, Mm^3	0.186	0.049	0.115	0.280
Atmospheric Pressure	0.007	0.938	-0.54	0.612
Wind Speed, Meter/Second	-0.177	0.063	-0.158	0.135

Table 3. Correlation coefficients between the number of positive cases and the meteorological data during the entire study period and on the days free of restrictions

Variables	Entire study period (112 days)		Days free of restrictions (91 days)	
	Correlation Coefficient	p value	Correlation Coefficient	p value
Mean Temperature, °c	0.004	0.965	0.014	0.892
Humidity Rate, %	0.236	0.012	0.226	0.031
Amount of Precipitation, Mm^3	0.172	0.071	0.116	0.273
Atmospheric Pressure	0.008	0.930	-0.61	0.565
Wind Speed, Meter/Second	-0.102	0.282	-0.095	0.370

Discussion

In the present study, in which we evaluated the relationship between COVID 19 presentations and meteorological parameters in Ankara, a city in the Central Anatolia region where the terrestrial climate is the dominant climate, we reached two conclusions. Firstly, there was a positive correlation between the number of presentations and the mean temperature and humidity rate. Secondly, when we compared the correlation between the number of positive cases and meteorological parameters, we found a positive correlation between the number of positive cases and the humidity rate. Although the number of presentations decreased during the days when the restrictions were in effect, we concluded that the restrictions did not affect the correlation between the number of patients and meteorological parameters.

The SARS-CoV-2 pandemic was designated by the World Health Organization as Coronavirus Disease 2019 (COVID-19). The COVID-19 pandemic started in China in late 2019; it has then spread around the globe and had a significant impact on every aspect of life. Meteorological parameters are among the important factors affecting the course of contagious diseases [4, 5]. Several studies have suggested that climate change may have contributed to the emergence and spread of various contagious diseases including SARS and COVID-19 [12]. For instance, some studies linked sharp changes in ambient temperature to an increased SARS risk [3]. It has been shown that influenza is generally more easily transmitted in cold and/or dry weather [13]. Low temperatures and low ultraviolet (UV) indices were correlated with increased influenza virus activity in Northern Europe between 2010 and 2018 [14]. In addition to human-to-human transmission, meteorological parameters are believed to be effective for the survival ability, transmission, and spread range of the viruses [9, 15]. Zhu and Xie analyzed the correlation between air temperature and COVID-19 infection in China, noting that the mean temperature and the number of COVID-19 cases had a positive linear association when the air temperature was below 3° C [16]. Similarly, Tosepu et al. analyzed the relationship between weather conditions and COVID-19 pandemic and showed that mean temperature (°C) was correlated with COVID-19 spread [17].

Biqing Chen investigated the effect of four meteorological parameters (air temperature, relative humidity, wind speed, and visibility) on COVID-19 infection; they reported that the parameters of the preceding 14 days were correlated to the number of cases [11]. We also showed that the number of hospital admissions was correlated to the mean temperature and humidity rate. In addition, we found that the number of PCR positive cases was only correlated to the humidity rate. In a systematic review that examined the effects of air temperature and humidity on the COVID-19 pandemic, it was reported that COVID-19 spread may be affected by climatic variables such as temperature and humidity, which may indicate that the SARS-CoV-2 virus may spread more slowly in warm and moist climates [18]. Bu et al. concluded that air temperatures ranging between 13 °C and 19 °C and humidity rates ranging between 50% and 80% are suitable for SARS-CoV-2 's survival and spread [19].

In addition to meteorological factors, social factors play a role in the coronavirus pandemic. As in many countries, our country has imposed restrictions on population movement, especially in the first months of the pandemic, to slow down the spread of COVID 19 and to prevent overloading of health systems. Although the number of presentations to our hospital and the number of positive cases were reduced during the period of restrictions, we showed that the restrictions did not affect the relationship between the number of cases and the meteorological parameters.

Limitations

Our study is a retrospective study. Data from a single hospital from a single city were used. In the first months of the pandemic, people arriving from various countries were quarantined. Since almost all of the first COVID-19 cases in Turkey were of foreign origin during the onset of the pandemic, these cases may have changed the case numbers in a given city. The results may show variability by regional geographic, climatic, and seasonal changes.

Conclusion

Meteorological factors may play a role in the transmission and pathogenesis of COVID-19. We showed a correlation between the number of presentations, the number of positive cases, and the mean temperature and humidity. Interactions between air pollution and meteorological factors may play a role in the transmission and pathogenesis of COVID-19, and such interactions can be better understood with multi-center prospective studies.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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